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Next-Generation Remote Sensing of Mars: A Mission in Very-Low (< 150 km) Orbit, Supported by Electric Propulsion

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We investigate the feasibility of missions in Low Mars Orbit (LMO), where atmosphere drag forces acting upon the spacecraft are compensated by an electric propulsion system. We show that a one-year mission is possible in a circular orbit at altitudes as low as 150 km. Such a mission opens opportunities for novel remote sensing approaches and new science cases. Given standard atmospheric models and assuming a medium-size spacecraft, the drag force within the Mars atmosphere acting upon the craft is approximately 100 mN at a height of 150 km, with a resulting orbit lifetime of less than two weeks. However, with typical parameters of an electric propulsion system like that on Dawn, the spacecraft would be capable to compensate this atmospheric drag by operating its ion thrusters. Remote sensing can benefit very much from operation in Low Mars Orbit. We anticipate new opportunities for next-generation spacecraft instrumentation including high-resolution imaging, radar sounding and Laser altimetry. We may (1) study seasonal and regional variations of snow-deposits in polar areas to improve models of the CO_2 cycle; (2) map polar areas at high resolution to study the dynamics of ice sheets and scarps; (3) map the intricate rotation function of the planet, in particular variations in length-of-day for modeling of inertia and seasonal mass-redistributions; (4) carry out magnetic field measurements at high spatial resolution to map anomaly patterns; (5) map temporal and spatial variations in the density structure of the low Martian atmosphere. We foresee exciting prospects to advance our understanding of the geodesy and dynamics of Mars.